

Disturbance Monitoring Package Statement of Work

1.0 Purpose

The hardware procured for the Disturbance Monitoring Package (DMP) must accurately measure change in angular position as a function of time on the SAGE III instrument payload. The data provided from the DMP instrument reference frame must measure change in angular position with accuracy resolvable to 0.25 arc seconds. The DMP will not be located on the instrument scan head, therefore data collected from the DMP measurements will be translated to the instrument scan head reference frame (optical axis) and be used to correct errors in field of view scans due to on-orbit disturbances. Figure 1.1 shows the integrated SAGE III instrument payload and the DMP will be located under the HEXAPOD. This document provides the DMP measurement performance, electronic interfaces, and mechanical interfaces that SAGE III desires to purchase. In addition Quality Assurance (QA) and statements of work are defined.

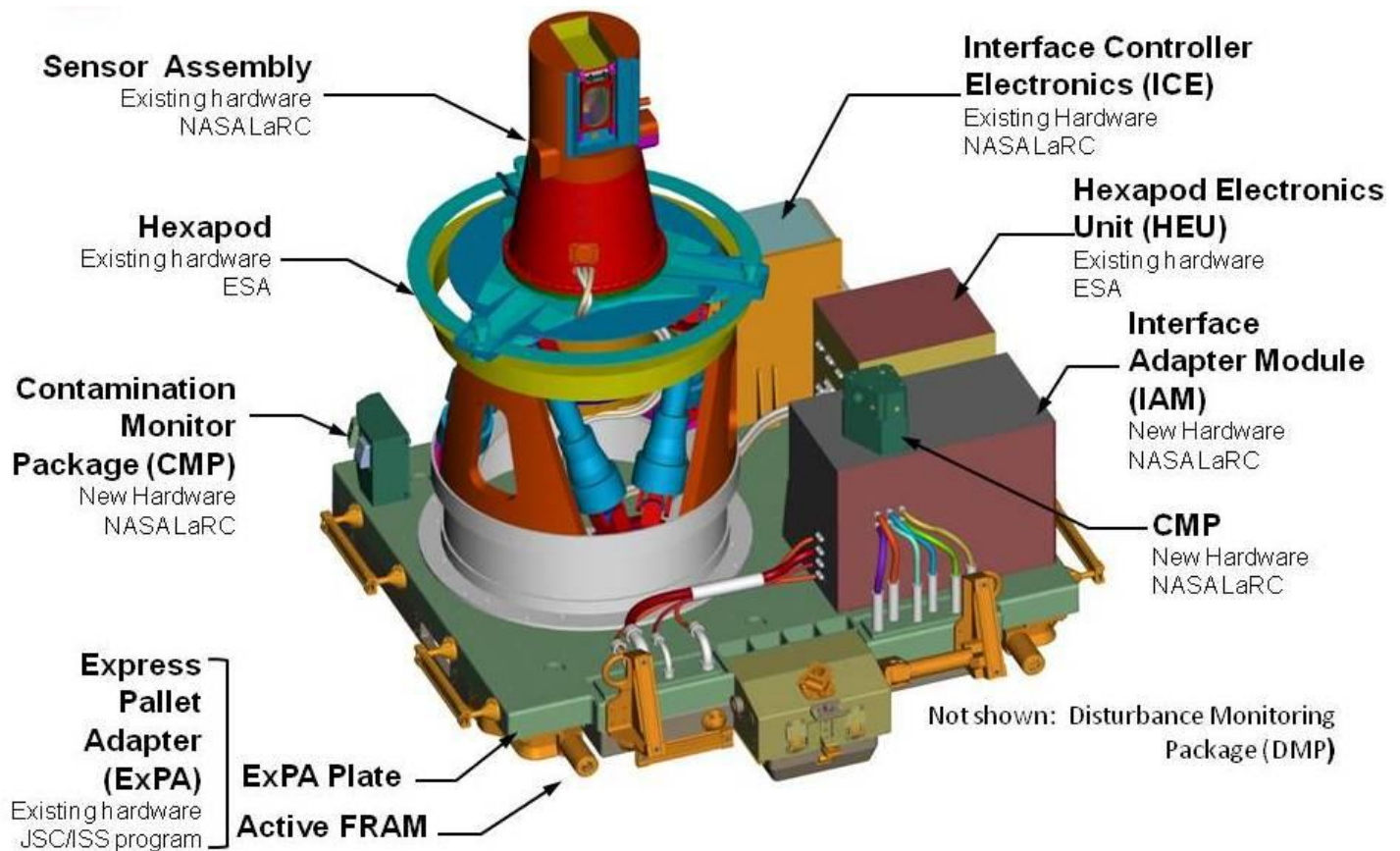


Figure 1.1: SAGE III Instrument Pallet

2.0 Scope

The Contractor shall provide a DMP that fully interfaces with the electrical and mechanical interfaces of the Interface Adaptor Module (IAM) and ExPA. The Contractor shall provide a DMP to meet or exceed the SAGE III requirements for disturbance data. The DMP must accurately measure disturbances due to on-orbit disturbances as described in this document. Disturbance Monitoring Package Overview

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3.0 Disturbance Monitoring Package Overview

The contractor shall deliver a DMP capable of measuring the on-orbit vibrations from International Space Station (ISS).

The contractor shall deliver a DMP that will provide angular position measurements, in the DMP reference frame, where the angular resolution is resolvable to less than 0.25 arc-seconds. LaRC will translate the DMP measurements to the instrument reference frame to obtain the angular displacement (angles) of the scan head.

The contractor shall interface with one of the IAM interfaces listed below. The IAM will furnish all electrical interfaces to the DMP as referenced in Table 1. The DMP shall interface with the IAM for power, command, and data interfaces available from the IAM referenced Table 2.

Table 1: IAM Power Interfaces

Operational Power		Notes
Option	Signal	
A	120 VDC	Operational Power is switched and monitored (Voltage and Current) by the IAM
B	28 VDC	

Table 2: Vendor Interface Responsibilities

Data Interfaces		Notes
Type	Signal	
Data	1553 Data Bus	±15V MIL-STD-1553B Bus. DMP can be a RT on the Bus.
Data	Synchronous Serial	IAM Interface is TIA/EIA-422-B electronic interfaces to an FPGA. Most standard synchronous serial interfaces can be accommodated by the IAM
Data	Asynchronous Serial UART	TIA/EIA-422-B electronic interfaces. Max Baud rate of 57600
Analog	Analog RTD Telemetry	The IAM provides Inputs for 1000Ω platinum 2-wire RTD thermistors
Analog	Analog General Purpose Telemetry	0-5V Analog Inputs are available on the IAM
Discrete	5V Discrete I/O	General Purpose IO can be configured for input or output by the IAM.
Discrete	28V Discrete Output	

4.0 DMP Functional/Performance Requirements

4.1 Performance

The contractor shall provide a DMP capable of measuring system disturbances. Disturbances are defined as the change in angular position of the DMPs reference frame caused by on –orbit structural vibrations. The DMP shall be capable of:

4.1.1 Providing angular displacement measurements at the DMP reference frame with an angular resolution resolvable to less than 0.25 arc-seconds.

4.1.2 The DMP shall be capable of measuring frequencies between 0.25 Hz and 64 Hz.

4.1.3 The DMP drift shall be less than 10 arcsec over a 2 minute data collection period

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4.1.4 The DMP shall provide valid displacement measurements when subjected to rotational rates up to 10 deg/sec.

4.1.5 The DMP shall provide displacement measurements in a local 3-axis orthogonal reference frame.

4.1.6 The DMP shall transmit disturbance measurement data over 1553 or RS422.

4.2 Electronics

The contractor shall provide a DMP capable meeting the following electrical requirements:

4.2.1 The IAM will provide the DMP either 28 VDC or 120 VDC power. The DMP shall be capable of fully operating at either the either 28 VDC or 120 VDC power.

4.2.2 The DMP shall comply with the IEEE parts plan: SAGE III-03-002 Electrical, Electronic, and Electromechanical (EEE) Parts Plan (See Appendix A – Reference Documents).

4.2.3 The DMP power consumption shall be less than 40 watts of power. Contractor shall deliver power estimates 2 weeks after contract award.

4.2.4 The contractor shall provide a DMP whose electronic components have >20Krad Radiation Total Dose, are Single Effect Upset (SEU) tolerant and are radiation Latch Up immune.

4.3 Grounding

The DMP shall provide a single point ground that is tied to the IAM Chassis as described in the SAGE III-ELE-051 'SAGE III / Meteor Electronics Grounding Description (See Appendix A – Reference Documents).

4.4 Data Telemetry

The contractor shall provide a DMP capable meeting the following data telemetry requirements:

4.4.1 The DMP shall provide disturbance measurement data on a high speed serial interface. In order to meet the performance requirement to be responsive to disturbances up to 64 Hz (reference section 4.1), the measurement data shall be at a rate greater than 128 Hz. The DMP shall transmit measurement data to one of the IAM interfaces specified in Table 2.

4.4.2 The DMP shall provide Health and Status data, including but not limited to voltage, temperature, and current measurements, on a serial interface listed in Table 2. The DMP shall transmit Health and status data at a nominal 1 Hz rate.

4.5 Time Accuracy

The DMP measurement data shall be accurately time stamped to <2ms.

4.6 Mechanical Constraints

4.6.1 The contractor shall deliver DMP CAD files in the form of IGES or Step files to be used for design and integration with the SAGE III instrument payload.

4.6.2 The contractor shall deliver a 2-D plan view drawings of the DMP mechanical interfaces to be used for designing mounting hardware between the DMP and SAGE III instrument payload.

4.6.3 The contractor shall deliver a DMP sensing axes that can be oriented with respect to identified externally accessible features of the DMP housing within 2 arc-seconds.

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4.7 Thermal Constraints

The contractor shall deliver thermal models of the DMP in Thermal Desktop format. The thermal model shall include models of electronics boards and critical components of the DMP. The contractor shall place temperature sensors on critical components and have a means to report those temperatures for model correlation. The contractor shall provide a DMP that has an operating range -20°C and 60°C.

4.8 Environmental Constraints

The DMP shall comply with the environmental constraints in the following documents referenced in Appendix A:

4.8.1 SSP 57012, FRAM Based Transported Payloads Interface Requirements Document.

4.8.2 SSP 57003-ELC, Attached Payload Interface Requirements Document - Expedite the Processing of Experiments to Space Station (ExPRESS) Logistics Carrier (ELC) Cargo Interface Requirements.

4.8.3 SAGE III -02 -005, SAGE III Contamination Plan.

4.8.4 The contractor shall provide documentation of environmental testing results.

4.9 Operational Life and Reliability

The contractor shall provide a DMP that meets the SAGE III mission requirement of a five year operational life with 90% reliability (Mean Time to First Failure).

4.10 Testing

The contractor shall conduct all testing as required in this section, or otherwise defined in this specification. The Contractor shall deliver test procedures two (2) weeks prior to each test for review and comments. The contractor shall deliver test reports and supporting analysis within two (2) weeks after completion of each test required in this specification and associated reference documents. The contractor shall perform the following:

4.10.1 The Contractor shall perform a 96 Hr Burn- In Test in accordance with the JSC 62592: GFE EEE Part Assembly Level Power Cycle Burn-in.

4.10.2 The contractor shall perform all of the testing listed in Table 2.6-1 which summarizes all thermal, vacuum, and humidity tests required for the DMP equipment. The contractor shall conduct all appropriate testing, and analysis necessary to demonstrate that the DMP meets all thermal requirements.

4.10.3 The Contractor shall bake-out all printed circuit boards and cables to meet the contamination requirements as stated in SAGE III-02-005 Contamination Control Plan.

4.10.4 The contractor shall conduct all appropriate testing and analysis necessary to demonstrate that the DMP hardware does not produce electromagnetic interference that degrades the safety and operation of the SAGE III payload. The DMP hardware shall not be susceptible to electromagnetic emissions from other components that could affect safety and performance. All EMC testing and analysis should comply with Section 2.5 of the GEVS document.

4.10.5 The contractor shall conduct all required vibration testing in accordance with GEVS Section 2.4.

4.10.6 The contractor shall conduct all appropriate testing and analysis necessary to demonstrate that the DMP meets structural and mechanical launch loads provided in NASA SSP 57012 and NASA SSP 57003.

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4.10.7 The Contractor shall perform a System Acceptance Test to validate that the supplied components meet the above specifications.

4.11 Weight Requirements

The contractor shall provide a DMP that has a mass not exceed 30 lbs. The contractor shall deliver mass estimates 2 weeks after contract award.

4.12 Size Requirements

The contractor shall provide a DMP capable meeting the following physical requirements:

4.12.1 The DMP unit shall fit within a 10 (Length) x 10 (Width) x 11 (Height) inch rectangular volume or a 12.5 inch diameter x 11 inch height cylindrical volume.

4.12.2 The contractor shall provide a DMP that meets structural and mechanical on orbit loads provided in NASA SSP 57003.

4.13 EEE Parts

The Contractor shall comply with the requirements in NASA Langley document: SAGE III-03-002 Electrical, Electronic, and Electromechanical (EEE) Parts Plan referenced in Appendix A.

4.14 Safety and Mission Assurance

The Contractor shall comply with the safety and mission assurance and government inspection requirements in the NASA Langley document: SAGE III-03-008 TQCM & Inertial Measuring Unit (IMU) Product Assurance and Safety Requirements. The Contractor shall deliver all items FOB Destination to NASA LaRC and shall ensure that shipping packaging and transportation is suitable to protect the engineering and spaceflight hardware. The Contractor shall ensure the product will not be damaged during shipping and follow the shipping and handling requirements specified in section 5.25 of the SAGE III-03-002, EEE Parts Plan.

4.15 Status Reporting

The contractor shall participate in bi-weekly status telecoms through delivery and acceptance of the flight unit. Telecoms will generally be accomplished in one hour or less. In addition, the contractor shall participate in detailed monthly reviews to be conducted via telecom or on-site at the contractor's facility, at the discretion of the Contracting Officer.

4.16 Milestone Schedule

The contractor shall develop and maintain a Milestone Schedule. This schedule shall be provided in electronic format. The schedule shall contain all of the contract events and milestones, accomplishments, tests, and activities from contract award to the completion of the contract. This information will be used to verify attainability of objectives, evaluate the progress of the contractor toward meeting objectives, and to integrate with SAGE-III program schedule.

4.17 Bi-Weekly Status Report

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The contractor shall submit bi-weekly status reports. Reports shall be in narrative form, brief, and informal. This report shall also provide updates to the Milestone Schedule.

4.18 Software and Firmware Manuals

The contractor shall deliver all software, firmware and drivers utilized and operational manual(s) that details how commands are communicated to the DMP and includes instructions for data retrieval.

4.19 Quality Plan

The contractor shall deliver a Quality Plan that fully demonstrates that the quality management systems are compliant with one of the following higher-level quality standards: AS9100, ISO 9001 or AS9003 standard. The Quality Plan shall also address the items listed in section 2.1 of the TQCM and IMU Product Assurance and Safety Document referenced herein.

4.20 End Item Data Package

The contractor shall deliver an End Item Data Package with the delivery of the DMP. The package shall consist of:

- Materials list
- Thermal-vacuum test correlated thermal model
- system As-built parts List including lot and date codes for all components
- As built electronics schematics and assembly drawings
- Documentation demonstrating completion of all qualification test requirements

4.21 DMP Instrument

The contractor shall fabricate and deliver a DMP Instrument that meets all performance requirements listed in the specification and associated reference documents.

5.0 Documentation and Deliverables

The contractor shall deliver the following documentation and deliverables:

Item No.	Spec Ref.	Deliverable Description	Qty.	Due Date	Delivery Instructions
5.1	4.16	Milestone Schedule	1 EA	Within 2 weeks after Contract award	- Delivered to TM and CO/CS (MS Project preferred)
5.2	4.17	Bi-Weekly Status Report	Bi-weekly	Bi-Weekly 1 st submittal due 4 weeks after Contract award	- Delivered to TM and CO/CS via email.

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Item No.	Spec Ref.	Deliverable Description	Qty.	Due Date	Delivery Instructions
5.3	4.6.1	DMP CAD files in PRO/E.	1 EA	Within 2 weeks after Contract award	<ul style="list-style-type: none"> - Delivered to TM. - Copy of submittal letter to CO/CS via email.
5.4	4.6.2	DMP 2-D plan view drawings in PRO/E.	1 EA	Within 2 weeks after Contract award	<ul style="list-style-type: none"> - Delivered to TM. - Copy of submittal letter to CO/CS via email.
5.5	4.7	Thermal models in Thermal Desktop models	1 EA	Within 2 weeks after Contract award	<ul style="list-style-type: none"> - Delivered to TM. - Copy of submittal letter to CO/CS via email.
5.6	4.2.3 and 4.11	Power and mass estimates	1 EA	Within 2 weeks after Contract award	<ul style="list-style-type: none"> - Delivered to TM. - Copy of submittal letter to CO/CS via email.
5.7	4.18	Software and firmware manuals	1 EA	Within 2 weeks after Contract award	<ul style="list-style-type: none"> - Delivered to TM. - Copy of submittal letter to CO/CS via email.
5.8	4.8.4	Environmental testing results	1 EA	Within 2 weeks after test	<ul style="list-style-type: none"> - Delivered to TM. - Copy of submittal letter to CO/CS via email.
5.9	4.10.1	Test Procedures for 96 Hr Burn- In Test	1 EA	2 weeks prior to test	<ul style="list-style-type: none"> - Delivered to TM. - Copy of submittal letter to CO/CS via email.

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Item No.	Spec Ref.	Deliverable Description	Qty.	Due Date	Delivery Instructions
5.10	4.10.1	Test Report for 96 Hr Burn- In Test	1 EA	Within 2 weeks after test	<ul style="list-style-type: none"> - Delivered to TM. - Copy of submittal letter to CO/CS via email.
5.11	4.10.2	Test Procedures for thermal cycles, vacuum, and humidity testing on the DMP	1 EA	2 weeks prior to test	<ul style="list-style-type: none"> - Delivered to TM. - Copy of submittal letter to CO via email.
5.12	4.10.2	Test Report for thermal cycles, vacuum, and humidity testing on the DMP	1 EA	Within 2 weeks after test	<ul style="list-style-type: none"> - Delivered to TM. - Copy of submittal letter to CO/CS via email.
5.13	4.10.3	Test Procedures for Bake-out	1 EA	2 weeks prior to test	<ul style="list-style-type: none"> - Delivered to TM. - Copy of submittal letter to CO/CS via email.
5.14	4.10.3	Test Report for Bake-out	1 EA	Within 2 weeks after test	<ul style="list-style-type: none"> - Delivered to TM. - Copy of submittal letter to CO/CS via email.
5.15	4.10.4	Test Procedures for EMC testing and analysis	1 EA	2 weeks prior to test	<ul style="list-style-type: none"> - Delivered to TM. - Copy of submittal letter to CO/CS via email.
5.16	4.10.4	Test Report for EMC testing and analysis	1 EA	Within 2 weeks after test	<ul style="list-style-type: none"> - Delivered to TM. - Copy of submittal letter to CO/CS via email.

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Item No.	Spec Ref.	Deliverable Description	Qty.	Due Date	Delivery Instructions
5.17	4.10.5	Test Procedures for vibration testing	1 EA	2 weeks prior to test	<ul style="list-style-type: none"> - Delivered to TM. - Copy of submittal letter to CO/CS via email.
5.18	4.10.5	Test Report for vibration testing	1 EA	Within 2 weeks after test	<ul style="list-style-type: none"> - Delivered to TM. - Copy of submittal letter to CO/CS via email.
5.19	4.10.6	Test Procedures for structural and mechanical launch loads testing and analysis	1 EA	2 weeks prior to test	<ul style="list-style-type: none"> - Delivered to TM. - Copy of submittal letter to CO/CS via email.
5.20	4.10.6	Test Report for structural and mechanical launch loads testing and analysis	1 EA	Within 2 weeks after test	<ul style="list-style-type: none"> - Delivered to TM. - Copy of submittal letter to CO/CS via email.
5.21	4.10.7	Test Procedures for System Acceptance Test	1 EA	2 weeks prior to test	<ul style="list-style-type: none"> - Delivered to TM. - Copy of submittal letter to CO/CS via email.
5.22	4.10.7	Test Report for System Acceptance Test	1 EA	Within 2 weeks after test	<ul style="list-style-type: none"> - Delivered to TM. - Copy of submittal letter to CO/CS via email.
5.23		Deliver Design Reliability Analysis (Section 3.3 of SAGEIII - 03-008 TQCM & IMU Product Assurance and Safety Requirements)	1 EA	Within 4 weeks after Contract award	<ul style="list-style-type: none"> - Delivered to TM. - Copy of submittal letter to CO/CS via email.

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Item No.	Spec Ref.	Deliverable Description	Qty.	Due Date	Delivery Instructions
5.24	4.19	Deliver Quality Plan (Section 2.1 of SAGEIII -03-008 TQCM & IMU Product Assurance and Safety Requirements)	1 EA	Within 4 weeks after Contract award	<ul style="list-style-type: none"> - Delivered to TM. - Copy of submittal letter to CO/CS via email.
5.25		Non-conformance Report (Section 2.6 of SAGEIII -03-008 TQCM & IMU Product Assurance and Safety Requirements)	1 EA	Within 3 business days after identification of non-conformance	<ul style="list-style-type: none"> - Delivered to TM. - Copy of submittal letter to CO/CS via email.
5.26		Failure Report (Section 2.6 of SAGEIII -03-008 TQCM & IMU Product Assurance and Safety Requirements)	1 EA	Within 3 business days after identification of failure	<ul style="list-style-type: none"> - Delivered to TM. - Copy of submittal letter to CO/CS via email.
5.27	4.20	Deliver End Item Data Package	1EA	Within 10 months after Contract award	<ul style="list-style-type: none"> - Delivered to TM. - Copy of submittal letter to CO/CS via email.
5.28	4.21	DMP Instrument	1 EA	Within 10 months after Contract award	<ul style="list-style-type: none"> - Delivered to TM. - Copy of submittal letter to CO/CS via email.

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Appendix A: Reference Documents

1. GSFC-STD-7000, "General Environmental Verification Standards (GEVS) For GSFC Flight Programs and Projects"
2. JSC 62592, " GFE EEE Part Assembly Level Power Cycle Burn-in"
3. NASA SSP 57003 Revision F, "Attached Payload Interface Requirements Document"
4. NASA SSP 57012, "ISS FRAM Based Payload Common Launch Interface Requirements Document"
5. SAGE III -02 -005, "SAGE III Contamination Plan"
6. SAGE III-03-002, "Electrical, Electronic, and Electromechanical (EEE) Parts Plan"
7. SAGE III-03-008 "TQCM & IMU Product Assurance and Safety Requirements"
8. SAGE III-ELE-051, "SAGE III / Meteor Electronics Grounding Description"

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Appendix B: Acronyms

Acronym	Definition
CMP	Contamination Monitoring Package
DMP	Disturbance Monitoring Package
EEE	Electrical, Electronic, and Electromechanical
ExPA	ExPRESS Pallet Adapter
ExPRESS	Expedite the Processing of Experiments to Space Station
FPGA	Field Programmable Gate Array
FRAM	Flight Releasable Attachment Mechanism
GEVS	General Environmental Verifications Standards
H&S	Health and Status
HEU	Hexapod Electronic Unit
IA	Instrument Assembly
IAM	Interface Adapter Module
ICE	Instrument Control Electronics
IGES	Initial Graphics Exchange Specification
ISS	International Space Station
LDEC	Launch Design and Environments Constraints (LDEC)
LaRC	Langley Research Center
NASA	National Aeronautics and Space Administration
RT	Remote Terminal
RTD	Resistive Thermal Devices
SAGE III	Stratospheric Aerosol and Gas Experiment III
SSP	Space Shuttle Program (ISS Document Prefix – SSP Document Number)
STEP	Standard for the Exchange of Product
QA	Quality Assurance
UART	Universal Asynchronous Receiver/Transmitter
VDC	Volts Direct Current